

CHAPTER ONE: INTRODUCTION.....	1
STUDY GOALS AND OBJECTIVES.....	1
REASONS FOR DOING THE STUDY	1
SCOPE OF REPORT	1
GEOGRAPHIC SCOPE.....	2
LIMITATIONS	2
INTENDED AUDIENCE.....	2
METHODOLOGY AND INFORMATION SOURCES.....	3
ANALYST CREDENTIALS.....	3
RELATED REPORTS	3
BCC ONLINE SERVICES.....	4
DISCLAIMER	4
 CHAPTER TWO: SUMMARY.....	 5
SUMMARY	5
<i>SUMMARY TABLE GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY TECHNOLOGY PLATFORM, THROUGH 2015 (\$ MILLIONS)</i>	 6
<i>SUMMARY FIGURE GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY TECHNOLOGY PLATFORM, 2009- 2015 (\$ MILLIONS)</i>	 6
 CHAPTER THREE: OVERVIEW	 7
INTRODUCTION	7
AGRICULTURE.....	8
TREE PRODUCTION.....	8
PULP PRODUCTION.....	9
BIOTECHNOLOGY, BIOPULPING, BIOBLEACHING, AND MICROBIAL ENZYMES	 10
PAPER PRODUCTION	11
ADHESIVES AND COATINGS	12
DISPOSAL AND RECYCLING.....	13
BIOREMEDIATION	14
Bioremediation (Continued).....	15
 CHAPTER FOUR: NANOTECHNOLOGY, CHARACTERISTICS AND APPLICATIONS.....	 16
INTRODUCTION	16
INTRODUCTION (CONTINUED)	17
BARRIER COATINGS.....	18
FUNCTIONAL COATINGS	18
CELLULOSE NANOBUILDING BLOCKS AND NANOFIBERS.....	19
ELECTROSTATIC SELF ASSEMBLY	20
NANOBIOCIDES.....	21
NANOSENSORS.....	21

NANOPARTICLES	22
NANOCLAYS	23
NANOPOWDERS.....	23
NANOSTARCH.....	24
CARBON NANOTUBES (CNTS)	24
CARBON NANOTUBES (CNTS) (CONTINUED).....	25
CHAPTER FIVE: PRODUCTS	26
BARRIER COATING PRODUCTS	26
TABLE 1 LEADING BARRIER COATING MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS.....	27
FUNCTIONAL COATING PRODUCTS.....	28
TABLE 2 LEADING FUNCTIONAL COATING MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS.....	28
TABLE 2 (CONTINUED).....	29
TABLE 2 (CONTINUED).....	30
CELLULOSE NANOBUILDING BLOCKS/NANOFIBER PRODUCTS	30
TABLE 3 LEADING CELLULOSE NANOBUILDING BLOCKS/NANOFIBER MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS.....	31
ELECTROSTATIC SELF ASSEMBLY (ESA) PRODUCTS	32
TABLE 4 LEADING ELECTROSTATIC SELF ASSEMBLY (ESA) MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS	32
NANOBIOCIDE PRODUCTS	32
TABLE 5 LEADING NANOBIOCIDE MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS	33
NANOSENSOR PRODUCTS	33
TABLE 6 LEADING NANOSENSOR MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS	34
NANOPARTICLE PRODUCTS.....	34
TABLE 7 LEADING NANOPARTICLE MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS	35
TABLE 7 (CONTINUED).....	36
TABLE 7 (CONTINUED).....	37
NANOSTARCH PRODUCTS	38
TABLE 8 LEADING NANOSTARCH MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS	38
CNT PRODUCTS.....	38
TABLE 9 LEADING CARBON NANOTUBE (CNT) MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS.....	39
TABLE 9 (CONTINUED).....	40
EMERGING TECHNOLOGIES AND APPLICATIONS.....	40
TABLE 10 EMERGING TECHNOLOGIES, MANUFACTURERS, PRODUCT LINES, AND APPLICATIONS.....	40
TABLE 10 (CONTINUED).....	41

SMART PAPER.....	41
BIOMIMETIC STRUCTURES	42
NANOFILMS.....	43
CHAPTER SIX: INDUSTRY DIRECTION AND RESEARCH.....	44
INTRODUCTION	44
GOVERNMENTAL INVOLVEMENT AND RESEARCH.....	45
NATIONAL NANOTECHNOLOGY INITIATIVE.....	46
Consultative Board for Advancing Nanotechnology	47
NANOTECHNOLOGY PATENTS	47
<i>TABLE 11 U.S. NANOTECHNOLOGY-RELATED PATENTS AND</i>	
<i>PATENT APPLCIATIONS APPLICABLE TO PULP AND PAPER</i>	<i>48</i>
<i>TABLE 11 (CONTINUED).....</i>	<i>49</i>
INDUSTRY AND ASSOCIATION RESEARCH INITIATIVES	49
AF&PA.....	50
Agenda 2020 Technology Alliance	51
FOREST PRODUCTS LABORATORY	51
HARVARD UNIVERSITY	52
Lieber Research Group.....	52
Center for Nanoscale System (CNS).....	53
Whiteside’s Research Group	54
LOUISIANA TECH UNIVERSITY	55
Institute for Micromanufacturing.....	55
PENN STATE UNIVERSITY	55
CNEU	56
NORTH CAROLINA STATE UNIVERSITY	56
Nanotechnology Initiative	57
NORTHWESTERN UNIVERSITY.....	57
IIN	57
IIN (Continued).....	58
Nanoscale Science & Engineering Center (NSEC)	59
CCNE	59
UNIVERSITY OF TENNESSEE.....	60
PURDUE UNIVERSITY.....	60
Birk Nanotechnology Center (BNC)	60
THE UNIVERSITY OF MAINE	61
Department of Chemical and Biological Engineering	
Process Development Center	61
Advanced Structures and Composites Center.....	62
Advanced Nanocomposites in Renewable Energy	
Laboratory (ANREL).....	63
GEORGIA TECH.....	63
Microelectronics Research Center (MiRC)	63
REGIONAL GROWTH IN NANOTECHNOLOGY RESEARCH	
FUNDING	64

IRELAND	64
UNITED STATES AND CANADA	65
JAPAN	65
HOLLAND AND BELGIUM.....	66
HEALTH, SAFETY, AND ENVIRONMENTAL ASPECTS OF NANOTECHNOLOGY	66
ENVIRONMENTAL PROGRAMS AND FUNDING	67
Environmental Programs and Funding (Continued)	68
Toxic Substances Control Act.....	69
Project on Emerging Nanotechnologies	70
Environmental Law Institute Nanotechnology Program	71
 CHAPTER SEVEN: MARKET	 72
INTRODUCTION	72
GLOBAL NANOTECHNOLOGY GROWTH BY PAPER TYPE.....	73
<i>TABLE 12 GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY PAPER TYPE, THROUGH 2015 (\$ MILLIONS)</i>	 74
GLOBAL NANOTECHNOLOGY EXPENDITURES BY END USE	74
<i>TABLE 13 GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY END USE, 2009 (\$ MILLIONS)</i>	 75
GLOBAL NANOTECHNOLOGY EXPENDITURES BY REGION	75
<i>TABLE 14 GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY REGION, 2009 (\$ MILLIONS)</i>	 75
GLOBAL NANOTECHNOLOGY GROWTH BY REGION.....	76
<i>TABLE 15 GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY REGION, THROUGH 2015 (\$ MILLIONS)</i>	 76
<i>TABLE 16 GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY REGION, THROUGH 2015 (\$ MILLIONS AND VOLUME IN MTS)</i>	 77
GLOBAL NANOTECHNOLOGY GROWTH BY END USE	77
<i>TABLE 17 GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY END USE, THROUGH 2015 (\$ MILLIONS)</i>	 77
GLOBAL NANOTECHNOLOGY GROWTH BY TECHNOLOGY	78
<i>TABLE 18 GLOBAL NANOTECHNOLOGY EXPENDITURES IN THE PAPER INDUSTRY BY TECHNOLOGY, THROUGH 2015 (\$ MILLIONS)</i>	 78
MARKET SHARE BY PAPER TYPE.....	79
<i>TABLE 19 MARKET SHARE OF NANOTECHNOLOGY IN THE PAPER INDUSTRY, BY PAPER TYPE, 2010 (% OF VALUE)</i>	 79
MARKET SHARE BY GLOBAL REGION.....	79
<i>TABLE 20 MARKET SHARE OF NANOTECHNOLOGY IN THE PAPER INDUSTRY, BY REGION, 2010 (% OF VALUE)</i>	 80
MARKET SHARE BY END USE	80

<i>TABLE 21 MARKET SHARE OF NANOTECHNOLOGY IN THE PAPER</i>	
<i>INDUSTRY BY END USE, 2010 (% OF VALUE)</i>	80
MARKET SHARE BY TECHNOLOGY PLATFORM.....	81
<i>TABLE 22 MARKET SHARE OF NANOTECHNOLOGY IN THE PAPER</i>	
<i>INDUSTRY BY TYPE OF TECHNOLOGY, 2010 (% OF VALUE)</i>	81

CHAPTER EIGHT: COMPANY PROFILES	82
INTRODUCTION	82
AKZONNOBEL NV	83
EKA CHEMICALS	83
Background	83
Company News	84
Products	84
Financial Performance	84
Strategic Direction.....	85
Distribution.....	85
ALBANY INTERNATIONAL.....	85
BACKGROUND	85
COMPANY NEWS	85
PRODUCTS	86
FINANCIAL PERFORMANCE	86
STRATEGIC DIRECTION.....	86
DISTRIBUTION.....	87
AMCOL INTERNATIONAL CORP.	87
NANOCOR.....	87
Background	87
Company News	87
Products	88
Financial Performance	88
Strategic Direction.....	88
Distribution.....	88
APPLETON	89
BACKGROUND	89
COMPANY NEWS	89
PRODUCTS	89
FINANCIAL PERFORMANCE	90
STRATEGIC DIRECTION.....	90
DISTRIBUTION.....	90
ASHLAND, INC.	91
ASHLAND HERCULES WATER TECHNOLOGIES	91
Background	91
Company News	91
Products	92
Financial Performance	92
Strategic Direction.....	93

Distribution.....	93
AWA PAPER MFG CO., LTD.....	93
BACKGROUND	93
COMPANY NEWS	94
PRODUCTS	94
FINANCIAL PERFORMANCE	94
STRATEGIC DIRECTION.....	94
DISTRIBUTION.....	94
DOMTAR.....	95
BACKGROUND	95
COMPANY NEWS	95
PRODUCTS	95
FINANCIAL PERFORMANCE	96
STRATEGIC DIRECTION.....	96
DISTRIBUTION.....	96
ECOLOGY COATINGS	97
BACKGROUND	97
COMPANY NEWS	97
PRODUCTS	97
FINANCIAL PERFORMANCE	97
STRATEGIC DIRECTION.....	98
DISTRIBUTION.....	98
ECOSYNTHETIX	98
BACKGROUND	98
COMPANY NEWS	98
PRODUCTS	99
FINANCIAL PERFORMANCE	99
STRATEGIC DIRECTION.....	99
DISTRIBUTION.....	99
EIKOS.....	100
BACKGROUND	100
COMPANY NEWS	100
PRODUCTS	100
FINANCIAL PERFORMANCE	101
STRATEGIC DIRECTION.....	101
DISTRIBUTION.....	101
FINETEX TECHNOLOGY, INC.....	102
BACKGROUND	102
COMPANY NEWS	102
PRODUCTS	102
FINANCIAL PERFORMANCE	103
STRATEGIC DIRECTION.....	103
DISTRIBUTION.....	103
GEORGIA-PACIFIC	103

BACKGROUND	104
COMPANY NEWS	104
PRODUCTS	104
FINANCIAL PERFORMANCE	105
STRATEGIC DIRECTION.....	105
DISTRIBUTION.....	106
GLATFELTER	106
BACKGROUND	106
COMPANY NEWS	106
PRODUCTS	107
FINANCIAL PERFORMANCE	107
STRATEGIC DIRECTION.....	107
DISTRIBUTION.....	108
IMERYS GROUP	108
BACKGROUND	108
COMPANY NEWS	108
PRODUCTS	109
FINANCIAL PERFORMANCE	109
STRATEGIC DIRECTION.....	109
DISTRIBUTION.....	110
INTEGRATED NANOTECHNOLOGIES, LLC	110
BACKGROUND	110
COMPANY NEWS	110
PRODUCTS	111
FINANCIAL PERFORMANCE	111
STRATEGIC DIRECTION.....	111
DISTRIBUTION.....	111
INTERNATIONAL PAPER	112
BACKGROUND	112
COMPANY NEWS	112
PRODUCTS	112
FINANCIAL PERFORMANCE	113
STRATEGIC DIRECTION.....	113
DISTRIBUTION.....	113
LIBERTY DIVERSIFIED INTERNATIONAL	113
DREAMWORKS COATING SOLUTIONS	114
Background	114
Company News	114
Products	114
Financial Performance	115
Strategic Direction.....	115
Distribution.....	115
MALVERN INSTRUMENTS, LTD.....	115
BACKGROUND	116

COMPANY NEWS	116
PRODUCTS	116
FINANCIAL PERFORMANCE	117
STRATEGIC DIRECTION.....	117
DISTRIBUTION	118
MICHELMAN, INC.	118
BACKGROUND	118
COMPANY NEWS	118
PRODUCTS	119
FINANCIAL PERFORMANCE	120
STRATEGIC DIRECTION.....	120
DISTRIBUTION	120
MONADNOCK PAPER MILLS, INC.....	120
BACKGROUND	120
COMPANY NEWS	120
PRODUCTS	121
FINANCIAL PERFORMANCE	121
STRATEGIC DIRECTION.....	121
DISTRIBUTION	121
MONDI, PLC.....	122
BACKGROUND	122
COMPANY NEWS	122
PRODUCTS	122
FINANCIAL PERFORMANCE	123
STRATEGIC DIRECTION.....	123
DISTRIBUTION	123
NANOINK, INC.	124
BACKGROUND	124
COMPANY NEWS	124
PRODUCTS	125
FINANCIAL PERFORMANCE	125
STRATEGIC DIRECTION.....	125
DISTRIBUTION	125
NANOLAB, INC.....	126
BACKGROUND	126
COMPANY NEWS	126
PRODUCTS	126
FINANCIAL PERFORMANCE	127
STRATEGIC DIRECTION.....	127
DISTRIBUTION	127
NANOMASK, INC.	127
BACKGROUND	127
COMPANY NEWS	127
PRODUCTS	128

FINANCIAL PERFORMANCE	128
STRATEGIC DIRECTION.....	128
DISTRIBUTION.....	128
NANOSONIC, INC.	129
BACKGROUND	129
COMPANY NEWS	129
PRODUCTS	129
FINANCIAL PERFORMANCE	130
STRATEGIC DIRECTION.....	130
DISTRIBUTION.....	131
NANOWORLD AG.....	131
BACKGROUND	131
COMPANY NEWS	131
PRODUCTS	132
FINANCIAL PERFORMANCE	132
STRATEGIC DIRECTION.....	132
DISTRIBUTION.....	132
SUN CHEMICAL.....	132
BACKGROUND	133
COMPANY NEWS	133
PRODUCTS	133
FINANCIAL PERFORMANCE	133
STRATEGIC DIRECTION.....	134
DISTRIBUTION.....	134
TOPCHIM	134
BACKGROUND	134
COMPANY NEWS	135
PRODUCTS	135
FINANCIAL PERFORMANCE	136
STRATEGIC DIRECTION.....	136
DISTRIBUTION.....	136
WAGENHOFER COATING SERVICES GMBH.....	136
BACKGROUND	137
COMPANY NEWS	137
PRODUCTS	137
FINANCIAL PERFORMANCE	137
STRATEGIC DIRECTION.....	138
DISTRIBUTION.....	138
APPENDIX	139
ABBREVIATIONS AND ACRONYMS	139
<i>TABLE 23 ABBREVIATIONS AND ACRONYMS</i>	139
<i>TABLE 23 (CONTINUED)</i>	140
<i>TABLE 23 (CONTINUED)</i>	141